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June 4, 2014

Mr. Michael Bower
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5800 Woolsey Canyon Road, MC T-487
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DRAFT STANDARDIZED RISK ASSESSMENT METHODOLOGY REVISION 2 ADDENDUM FOR THE SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CALIFORNIA

Dear Mr. Bower:

The Department of Toxic Substances Control's (DTSC) Human and Ecological Risk Office (HERO) has reviewed the Standardized Risk Assessment Methodology Revision 2 Addendum (SRAM Rev. 2 Addendum) for the Santa Susana Field Laboratory. HERO's comments on the SRAM Rev. 2 Addendum are presented in the attached memorandum.

The SRAM Rev. 2 Addendum was prepared and submitted to DTSC to document updates to the human health and ecological risk assessment approach, methods, assumptions and toxicity criteria that are presented in the SRAM Rev. 2. The SRAM Rev. 2 was approved by DTSC in 2005.

If you have any questions regarding DTSC's comments or would like to schedule a meeting to discuss the attached comments, please contact Don Greenlee at Donald.Greenlee@dtsc.ca.gov or (818) 717-6594, or myself at Roger.Paulson@dtsc.ca.gov or (916) 255-3702.

Sincerely,

Roger N. Paulson, PE
Senior Engineer
Santa Susana Field Laboratory Office
Department of Toxic Substances Control

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Attachments: *HERO Comments on the Draft SRAM-2 Addendum*
SRAM-2 Addendum

cc: (via e-mail)

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TO: Roger Paulson, SSFL-Boeing Sites Project Manager – DTSC-Sacramento

FROM: Donald V. Greenlee, Ph.D., DABT
Staff Toxicologist

DATE: May 29, 2014

SUBJECT: HERO Comments on the Draft SRAM-2 Addendum for the Santa Susana Field Laboratory, 5800 Woolsey Canyon Road, Canoga Park, CA 91304, dated January 2014.

PCA: 22120 Site Code: 300232-48

The Human and Ecological Risk Office (HERO) of the Department of Toxic Substances Control (DTSC) reviewed the Draft SRAM-2 Addendum for the Santa Susana Field Laboratory (SSFL), comprised of Attachment 1 ("Annotated Standardized Risk Assessment Methodology Work Plan, Santa Susana Field Laboratory,..."), Appendix A ("Process for Selecting the Comprehensive List of Chemicals for Development of Rural Residential Risk-Based Screening Levels for Soil...") and Appendix B (Human Health Risk-Based Screening Levels Technical Memorandum). These documents were prepared by MWH Americas, Inc. (Arcadia, CA) on behalf of The Boeing Company. This is an exception report, which lists only discrepancies identified by HERO in the above documents, inclusive of associated Risk-Based Screening Level (RBSL) tables for soil prepared for a variety of receptor exposure scenarios.

Background

The Standardized Risk Assessment Methodology Workplan (SRAM) was originally prepared through collaborative efforts of the three responsible parties for SSFL (Boeing, NASA and the federal Department of Energy (DOE)) and the California Department of Toxic Substances Control (DTSC). As of June 2005, the SRAM was revised, resulting in the SRAM-Revision 2 (SRAM-2). In December of 2010, NASA and DOE signed Agreements on Consent (AOCs) in which they each agreed to cleanup chemical- and/or radiological-impacted SSFL RCRA Facility Investigation sites (RFI sites) for which they were responsible. The AOCs require cleanup to background levels, and therefore do not involve risk assessment, or risk-based site closures. Thus, Boeing is the only remaining RP to pursue health-risk based closures at its SSFL RFI sites. Thus, the reviewed documents pertain exclusively to Boeing practices at SSFL.

© [illegible]

SRAM-2 is a "living document," meaning that key components of it must be kept up to date to ensure that Boeing's portion of SSFL is remediated using the most current risk assessment information available, so that remediated conditions are as protective of public health as possible. This ensures, for example, that the most recent cancer and non-cancer toxicity factors, derived from the most recent research results, are used to estimate human health risks for site closures. At the request of Boeing and the DTSC, MWH has updated SRAM-2 as of January 2014. The SRAM-2 revision incorporates several Technical Memos (TMs) that have been proposed by Boeing and reviewed and approved earlier by DTSC. These TMs are intended to make the risk assessment process for both human health and ecological endpoints more transparent and easy to understand, while also providing a rigorous and comprehensive risk evaluation.

For example, Boeing will employ a "Sum of Fractions" approach to evaluating health risks at each RFI site. This method establishes a proportion between the concentration of the chemical in soil that yields a cancer risk of 1.0E-6 (or a non-cancer hazard quotient (HQ) of 1.0), and the unknown cancer risk (or HQ) corresponding to a measured concentration of this same chemical in soil. This Sum of Fractions method is applicable because calculated cancer risks (or HQs) are directly proportional to measured soil concentrations. The Sum of Fractions approach has been established for some time, and risk-based screening equations used in this approach are provided in the User's Guide to USEPA-Region IX's Regional Screening Level (RSL) tables, available on their website at: http://www.epa.gov/region9/superfund/prg/.

Because all estimated soil cancer risks and HQs will rely on risk-based screening levels (RBSLs) calculated in the SRAM-2 Revision, it is essential that these RBSLs be correctly calculated, otherwise risk calculation errors could be propagated using the Sum of Fractions method. Hence, the goal of this review was to ensure that the entire SRAM-2 Revision was correct and approved by DTSC, including the logic behind the SRAM-2 revisions and associated text explanations, and the RBSL values calculated for the 185 Chemicals of Potential Concern (COPC). In fact, six sets of RBSLs were calculated, each corresponding to the following hypothetically exposed individuals: a suburban resident, a rural-farmer resident with a 30 yr exposure, a rural-farmer resident with a 40-yr exposure, a recreational receptor and as required by SRAM-2, separate dietary exposures to home-grown vegetables and fruits that constitute either 25% of one's diet (USEPA default-based Suburban Residential Garden receptor) or 100% of one's diet (SRAM-based Suburban Residential Garden receptor). HERO reviewed all of this information, and our comments are provided below.

General Comments: Based on the amount of information reviewed, the overall quality of the SRAM-2 Revision including text, tables, figures and RBSL calculations were excellent. Self-explanatory comments are provided below according to the document orientation, eg, Attachment-1, Appendix B, etc.

ATTACHMENT-1

1. **Page 7-3, Section 7.3 (Chemical-Specific Toxicity Criteria):** The updated hierarchy for selection of sources to provide toxicity values is listed in Appendix B of the SRAM-2 Addendum. HERO recommends that Table 3 of HERO HHRA Note Number 3, which pertains only to VOCs, be added to this list for selected Inhalation Unit Risk Factors (URFs) and R_fCs or RELs, as discussed in more detail under "Appendix B" below.

Appendix B HHRBSL TM– Attachment 1: Risk-Based Screening Levels Calculation Approach and Equations

2. **Page 3, Section 2.1 (Exposure Pathways Addressed by RBSLs):** The two Conceptual Site Model (CSM) figures mentioned in the first paragraph (ie, Figure 1 (Suburban Residential and Recreational CSM) and Figure 2 (Rural Residential CSM)) should be harmonized to ensure consistency. The following observations pertaining to these figures were made:

   - **Figure 1:** The double asterisk footnote that refers to ingestion of edible vegetation states that "Exposure is limited to bioaccumulatable compounds as described in the text." After reviewing the text, no discussion of bioaccumulatable compounds was found in reference to chemical uptake into garden vegetables/fruits. Further, it is not necessary to have "bioaccumulation" in order to be exposed to toxic levels of chemicals taken up by plants. Thus, it is HERO's opinion that the above statement be removed from the double asterisk footnote in Figure 1.

     The single-asterisk footnote needs to be reconciled with the footnote in Figure 2. In Figure 1, this footnote refers to the inhalation pathway for vapors and it states: "Exposure is limited to volatile compounds; residential receptors include both indoor and outdoor air exposure to volatiles; recreational receptors include only outdoor air exposure. For residents, inhalation of volatiles from groundwater beneath a site includes migration to indoor air, but does not include groundwater-to-ambient air pathways because these pathways have been shown to be insignificant at the SSFL."

     In view of the fact that these are soil RBSLs, not groundwater RBSLs, HERO recommends the following reconstruction of the above paragraph: "Exposure to vapors refers to volatile organic compounds (VOCs). While both residential and recreational receptors are exposed to outdoor vapors, only residential receptors are also exposed to indoor vapors. Residential indoor air vapor intrusion risks arising from soil vapor and/or VOC volatilization from groundwater will be evaluated separately as described in the technical memorandum entitled "An Updated Approach for Assessing the Vapor Intrusion Pathway, Boeing RCRA Facility Investigation Project, Santa Susana Field Laboratory, California" (CH2M Hill, 2011).

Finally, under the secondary release mechanism labeled as "Sediment," please add a fourth box labeled "Inhalation (dust)" under the column labeled "Exposure Route." This will aid consistency with Figure 2.

- **Figure 2:** Please re-word the footnote denoted with a single asterisk. The same wording suggested for Figure 1 above can be used.

3. **Page 34, Section 3.2.3 (Lead):** A misprint was noted on page 34 towards the end of the paragraph carried over from page 33 ("...which approximate to an exposure frequency of 75 days/week, was entered..."). This should read 75 days/year.

4. **Page 35, Section 3.3 (Toxicity Values):** As documented in HERO Note 3 (available at: http://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm), HERO has recently revised their recommended methodology for application of USEPA Region-IX Regional Screening Level (RSL) values. In general, this document supports EPA's selection of the majority of RSL values listed in the RSL tables (http://www.epa.gov/region9/superfund/prg/). As a corollary, the toxicity values used by USEPA are also generally endorsed, although exceptions exist for VOCs. Table 3 in HHRA Note 3 lists the more protective cancer inhalation unit risk factor (IUR) or non-cancer reference concentration/Reference Exposure Level (R_fC/REL) for several VOCs. Please ensure that toxicity values for those VOCs on the expedited chemical list (yellow highlighted VOCs on Attachment 1-Table 4 in Appendix B of the SRAM-2 Revision) coincide with those shown on HERO HHRA Note 3. This includes the following VOCs and toxicity value corrections:

VOC	RfC or REL (mg/m^3)
Carbon tetrachloride	4.0E-2
Methylene chloride	4.0E-1
Tetrachloroethylene	3.5E-2
Toluene	3.0E-1

HERO recognizes that the remainder of toxicity values on Table 4-Appendix B (non-highlighted values) will be revised later, prior to finalizing risk evaluations for RFI sites. At that time, Table 3 of HHRA Note 3 should be used to ensure that IURs/R_fCs/RELs for all listed VOCs applicable to Boeing's portion of SSFL are updated.

Other corrections to toxicity values for chemicals on the expedited list (yellow highlight in Attachment 1-Table 4) and otherwise that are not included in HERO HHRA Note 3 included the following:

Chemical	RfC or REL (mg/m^3)	URF $(ug/m^3)^{-1}$	Reference
1,2-Dibromoethane	8.0E-4	--	OEHHA
Chrysene	--	1.1E-5	OEHHA

This is not an all-inclusive list because HERO understands that toxicity value corrections throughout Table 4 will be addressed prior to site closures. HERO also noted that the URF for trichloroethylene in Table 4 referred to footnote "g" but this footnote was not included in the legend. Please add it if it is important.

One minor note: the acronym REL refers to Reference Exposure Level, not "recommended exposure limits" as stated at the bottom of page 35 in Appendix B, Section 3.3.

Comments on RBSL Calculation Spreadsheets:

5. **30-Year Rural Residential Spreadsheets:** The Exposure Parameters worksheet (ie, "Att2c Tb4 Exposure Parameters") enclosed within the "HHRA RBSL Workbooks_4_USEPA_30 yr RR" Excel spreadsheets is missing the following input values under the following categories:

   General:
   Exposure Frequency
   Dermal Contact with Soil:
   Skin surface areas for rural residential child and farmer

6. **USEPA-based Suburban Residential Garden RBSL Calculations:** Within the Excel spreadsheets entitled "HH RBSL Workbooks_3_40 yr ED RR_Garden," the value for the fraction of produce consumed by the Suburban Resident that is contaminated (CF_p = 0.25) is not specified on Att2b_Tb2_Res-garden RBSL worksheet, nor is it specified on Att2b_Tb5_Exposure Parameters worksheet. Please ensure that all input parameters are listed, and organize them such that the reader clearly understands which parameter values pertain to a certain worksheet.

7. **Volatilization Factor Worksheet:** The Volatilization Factor (VF) worksheets, entitled "Att 2a_Tb8_VF" in spreadsheets "HHRBSL Workbooks_2_Suburban_Garden_Rec" and in "HHRBSL Workbooks_3_USEPA_40-yr ED RR_Garden" and entitled "Att 2c_Tb7_VF" in spreadsheets "HHRBSL Workbooks_4_USEPA_30 yr ED RR" are consistently missing the diffusivity in water parameter, (ie, D_w) from the numerator in the apparent diffusivity (DA) equation as follows:

$$D_A = \{(\phi_a^{(10/3)} \times D_i \times H'\} + \{\phi_w^{(10/3)} \times \mathbf{D_w}\}/\text{denominator}$$

   Please ensure that this equation is accurate per Equation 4-8 in USEPA's "Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites," (December 2002), and recalculate VFs and soil RBSLs for VOCs.

8. **RBSL Calculation Spreadsheets**: HERO spot-checked soil RBSL calculations for a variety of chemicals using the following exposure scenarios:

Suburban Residential
SRAM-based Suburban Residential Garden
USEPA Default-based Suburban Residential Garden
40-Year Rural Residential
30-Year Rural Residential
Recreational Receptor

With the exception of the equation for the Volatilization Factor (VF) mentioned above, RBSL equations were identical to those supplied in USEPA-Region IX's RSL Table User's Guide, where exposure parameters were either USEPA default values or those supplied in SRAM-2, as appropriate. Chemical-specific parameters were provided from referenced, publically-available information. Except for the VF and related estimates of exposures to VOCs in ambient air, soil RBSLs were correctly calculated.

Reviewed by:

William Bosan, PhD
Senior Toxicologist
Human and Ecological Risk Office

MWH

BUILDING A BETTER WORLD

TECHNICAL MEMORANDUM

To:	Mike Bower, Boeing	**Date:**	May 16, 2014
From:	Gilbert Dimidjian, MWH	**Reference:**	10504105
Subject:	*Final* Development of Risk Based Screening Levels for Additional Groundwater Constituents, and Screening Level Clarifications at the Santa Susana Field Laboratory, Santa Susana, California		

This technical memorandum has been prepared to document the development of new chemical-specific risk-based screening levels (RBSLs) for a specific set of chemicals for which groundwater screening criteria were not previously developed, and to clarify groundwater screening levels for certain chemicals at Santa Susana Field Laboratory (SSFL) in support of Boeing's data quality objectives process for completing site characterization.

Development of RBSLs for Additional Constituents

During Data Quality Objectives Vadose Zone to Groundwater Mass Flux (DQO) evaluations, it was determined that screening levels are not available in Table 2 of Appendix D, *Recommended Approach for Evaluating Vadose Zone Mass Flux of Contaminants to Groundwater* (CH2M Hill, 2013) and are needed for a subset of polycyclic aromatic hydrocarbons (PAHs), that include 1-methylnaphthalene, acenaphthene, acenaphthylene, fluoranthene, and fluorene. RBSLs for these compounds were calculated using the same methodology (described in Appendix 7-C of the *DRAFT Site-Wide Groundwater Remedial Investigation Report* [MWH, 2009]) as for the other RBSLs in Table 2, and using current toxicity factors (USEPA, 2014).

Consistent with the methods presented by MWH (2009), groundwater RBSLs were calculated separately for a hypothetical future child suburban resident and a hypothetical future adult suburban resident exposed to the above PAHs in groundwater through potable uses of the groundwater. In the case of 1-methylnaphthalene, which exhibits both carcinogenic and non-carcinogenic properties, groundwater RBSLs were calculated for both carcinogenic effects and non-carcinogenic effects. The lower, more protective, of all the groundwater RBSLs for a given PAH were selected as the DQO screening level. The newly calculated RBSL's (2014) for the above-referenced PAHs are presented below:

Constituent	Groundwater RBSLs – Suburban Resident (2014) (µg/L)
1-Methylnaphthalene	2.6
Acenaphthene	380
Acenaphthylene	380
Fluoranthene	250
Fluorene	250

Notes:
µg/L – micrograms per liter
PAHs – polycyclic aromatic hydrocarbons
RBSLs - risk-based screening levels

Screening Level Clarifications

The screening levels presented in Table 2 of Appendix D (CH2M Hill, 2013) for 2,3,7,8-TCDD and benzo(a)pyrene and their respective toxic equivalence quotients (TEQs), were a confusing mix of drinking water primary maximum contaminant levels (MCLs) and RBSLs. Because MCLs take precedence over RBSLs in the approved screening level hierarchy, only the MCLs for 2,3,7,8-TCDD and benzo(a)pyrene should have been presented in Table 2 of Appendix D (CH2M Hill, 2013). Furthermore, the 2,3,7,8-TCDD TEQ and benzo(a)pyrene TEQ are properly compared to the screening values for those individual compounds, and so these TEQs did not need to be listed separately in Table 2 of Appendix D (CH2M Hill, 2013).

In summary, the 2,3,7,8-TCDD TEQ, which accounts for the cumulative toxicity of all the detected dioxin and furan congeners that are chlorinated in all four of the 2, 3, 7, and 8 positions, will be calculated for each groundwater sample and screened against the 2,3,7,8-TCDD MCL of 0.00003 µg/L. Similarly, the benzo(a)pyrene TEQ, which accounts for the cumulative toxicity of the seven generally recognized carcinogenic PAHs, will be calculated for each groundwater sample and screened against the benzo(a)pyrene MCL of 0.2 µg/L.

Conclusions

It is recommended that the additional RBSLs and screening level clarifications described above be adopted for use during the DQO evaluations.

References

CH2M HILL, 2013. "Comprehensive Data Quality Objectives, RCRA Field Investigation," Santa Susana Field Laboratory, Ventura County, California. March.

MWH, 2009. "DRAFT Site-Wide Groundwater Remedial Investigation Report," Santa Susana Field Laboratory, Ventura County, California. December.

United States Environmental Protection Agency (USEPA). 2014. Integrated Risk Information System (IRIS) Database. Accessed on-line at: http://www.epa.gov/iris